Section II. REMARKS

The pending claims in the application are claims 1-33, 38-45 and 50-57.

Claim Objections

Claim 43 was objected to because it contained a typographical error. Accordingly, claim 43 has been amended herein to correct such typographical error and obviate this objection.

Claims 40-43 and 46-49 were objected to under 37 C.F.R. §1.75 as being a substantial duplicate of claims 34-37 and 50-53, respectively. Accordingly, claims 34-37 and 46-49 have been cancelled herein.

Double Patenting

In the July 15, 2003 Office Action, claims 1-56 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-15 of Wojtczak et al. (U.S. Patent No. 6,527,819) in view of Kaufman et al. (U.S. Patent No. 6,063,306)

In response, a terminal disclaimer is enclosed and submitted herewith under the provisions of 37 C.F.R. §1.321(c), to overcome the obviousness-type double patenting rejection raised by the Examiner.

Rejection of Claims and Traversal Thereof

In the July 15, 2003 Office Action:

claims 1-56 were rejected under 35 U.S.C. §112, second paragraph;

claims 1-8, 10-17 and 20-56 were rejected under 35 U.S.C. §103(a) as being unpatentable over Mravic et al. (U.S. Patent No. 6,083,840) in view of Kaufman et al. (U.S. Patent No. 6,063,306); and

claim 1 was rejected under 35 U.S.C. §103(a) as being unpatentable over Kaufman et al. alone, or alternatively in view of Farkas et al. (U.S. Patent No. 6,001,730).

These rejections are traversed and reconsideration of the patentability of the pending claims is requested in light of the following remarks.

Rejection under 35 U.S.C. §112, second paragraph

In the July 15, 2003 Office Action, claims 1-56 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention.

The Examiner has raised numerous grounds for such §112, second paragraph rejection and each rejection is addressed in turn below.

1) Claim 1 was rejected under §112, second paragraph, as being indefinite on the basis that the terminology "high removal rate," "low removal rate" and "comparable removal rate" are relative terms with no basis for comparison. This is not correct, since the terms at issue are not unbased comparatives - they are terms relationally specified to one another. There is nothing improper in this language. Nonetheless, to resolve the issues and advance the prosecution of the application, applicants have amended claim 1 to relationally specify the rates of removal in alternative language. Claim 1 now recites, *inter alia*:

> **"A method for chemical mechanical polishing copper, barrier material and dielectric material, the method which comprises the steps of:**
> **a) providing a first chemical mechanical polishing slurry wherein said first slurry has a higher removal rate on copper relative to a lower removal rate on said barrier material;**
> **. . .**
> **c) providing a second chemical mechanical polishing slurry having an oxidizing agent to a corrosion inhibitor weight ratio less than one, wherein said second slurry has a higher removal rate on said barrier material relative to a lower removal rate on said dielectric material and an intermediate removal rate on copper; and . . . ."**

Claim 1, as amended, specifies the removal rates of the first and second slurries with respect to copper, barrier material and dielectric in clear and precise terms. For example, with regards to the first chemical mechanical polishing (hereinafter CMP) slurry, the removal rate on copper exceeds the removal rate on the barrier material. As such, claim 1 fully complies with the requirements of 35 USC § 112, second paragraph.

The Examiner is reminded that the acceptability of the claim language depends on whether one of ordinary skill in the art would understand what is claimed, in light of the specification. See MPEP §2173.05(b). Referring to the specification, applicants describe the first slurry as a copper selective slurry. Thus, the removal rate of copper is higher than that of the barrier material (see page 7, lines 16-

17). Further, applicants describe the second slurry as selective to the barrier material relative to the copper and dielectric layer (see page 7, lines 19-20). The Examiner's attention is also directed to Tables 1-3 in applicants' instant specification, in respect of the relativistic terms of claim 1 as amended.

2) Claims 2, 9, 18 and 19 were rejected under §112, second paragraph, as being indefinite on the basis that the terminology "greater than about" and "less than about" is indefinite. Although the term "about" is fully sanctioned by the case law and USPTO practice as acceptable claims terminology, applicants nonetheless have amended claims 2, 9, 18 and 19 to remove the term "about," thereby obviating this rejection, in the interest of expediting the prosecution and allowance of the instant application.

In light of the foregoing, applicants respectfully request withdrawal of the §112, second paragraph rejections of claims 1-56.

Rejection under 35 .U.S.C. §103(a)

In the July 15, 2003 Office Action, claims 1-8, 10-17 and 20-56 were rejected under 35 U.S.C. §103(a) as being unpatentable over Mravic et al. (U.S. Patent No. 6,083,840) (hereinafter Mravic) in view of Kaufman et al. (U.S. Patent No. 6,063,306) (hereinafter Kaufman). Applicants respectfully traverse this rejection and submit that Mravic in combination with Kaufman does not in any way teach or suggest applicants' claimed invention.

As discussed hereinabove, applicants' claimed first CMP slurry provides a rate of removal of copper that exceeds the rate of removal of barrier material, to ensure that copper is preferentially removed during the first step of CMP processing. Further, the claimed second CMP slurry provides the following relative rates of removal during the second step of CMP processing: barrier material > copper > dielectric material.

Mravic teaches a two-step CMP process wherein the first step utilizes a bulk copper removal slurry, which is formulated to rapidly remove copper on the substrate during the first step of CMP processing. The second slurry, a 1:1:1 selectivity copper/tantalum/silicon dioxide ($Cu/Ta/SiO_2$) slurry, is useful "for polishing copper, copper adhesion promoting layers [i.e. barrier materials] and silicon based layers at approximately equal polishing rates to prevent dishing and erosion of the copper in trenches and vias" (see Mravic, col. 7, lines 44-47 and col. 4, lines 63-67). Thus, the second slurry has no preference for barrier material relative to copper or dielectric material.

Kaufman also teaches a two-step CMP process, wherein the first step utilizes a slurry that is useful for polishing the copper portion of a copper containing substrate at high rates. The second step of the Kaufman process utilizes a slurry that "exhibits a low polishing rate towards copper and a typical polishing rate towards tantalum or tantalum nitride" (i.e., barrier materials) (see Kaufman, col. 7, lines 24-26).

According to the Examiner, it would have been obvious to one of ordinary skill in the art to incorporate the first slurry composition and method of Mravic with the second slurry composition and method of Kaufman because both are used for the same purpose (see July 15, 2003 Office Action, page 5, lines 8-10). Further, the Examiner contends that "the combined prior art is silent in the polishing rate of [the] dielectric layer" (see July 15, 2003 Office Action, page 5, lines 10-11). Applicants vigorously disagree.

Contrary to the Examiner's contention, the combined prior art is not silent regarding the polishing rate of the dielectric layer. Notably, applicants' dielectric materials are preferentially silicon oxides (see instant specification, page 7, lines 1-3). As stated hereinabove, Mravic discloses a second slurry composition having a 1:1:1 $Cu/Ta/SiO_2$ selectivity that is useful "for polishing copper, copper adhesion promoting layers [i.e., barrier materials] **and silicon based layers** [i.e., dielectrics] **at approximately equal polishing rates** to prevent dishing and erosion of the copper in trenches and vias" (see Mravic, col. 7, lines 44-47). As such, Mravic expressly teaches that the rate of removal of the dielectrics should be approximately equal to that of the rate of removal of the copper and the barrier material. In fact, referring to Example 3 of the Mravic patent, the rate of removal of silicon dioxide (i.e. dielectrics) was **greater than** the rate of removal of copper or barrier material (see Mravic, col. 9, lines 58-60).

Further, the characteristics of the second slurry of Kaufman can be discerned by examining the results of three experiments compiled in Table 4 of Kaufman, recreated hereinbelow for ease of reference:

Slurry (weight %)	Cu removal rate, Å/min	Ta removal rate, Å/min	PETEOS[1] Rem. rate, Å/min	Cu:Ta selectivity	oxid/corr.[2,3] weight ratio
1 2% alumina, 5% H_2O_2, 0.5% tartaric, pH 7.0	651	337	64	1.9:1	10:1

[1] PETEOS is the acronym for plasma-enhanced deposition of oxides from TEOS, wherein TEOS is tetra-ethyl-ortho-silicate, or equivalently tetra-ethoxy-silane. TEOS is a relatively inexpensive, safe source for silicon dioxide.
[2] Oxidizing agent/corrosion inhibitor weight ratio, calculated by applicants using the disclosed slurry compositions. Oxidizing agents include H_2O_2 and urea. Corrosion inhibitors include tartaric and acetic acid.
[3] Notably, Kaufman's "complexing agents" and applicants' "corrosion inhibitors" relate to the same class of compounds (carboxylic acids). Examples of "corrosion inhibitors" include carboxylic acids such as iminodiacetic acid (see present specification, page 10, lines 18-23 through page 11, line 1). Examples of "complexing agents" include acids such as citric, lactic, malonic, tartaric, succinic, acetic, oxalic and amino acids, all of which are carboxylic acids (see Kaufman, col. 5, lines 58-65).

2	5% alumina, 5% H_2O_2, 0.2% tartaric, 0.2% acetic, 2% urea, 0.08% BTA, 50 ppm Triton DF-16, pH 6	260	244	8	1:1	17.5:1
3	3% alumina, 5% H_2O_2, 0.2% acetic acid, 0.08% BTA, 50 ppm Triton DF-16, pH 5	66	299	135	1:4.5	25:1

Specifically, it is seen that Kaufman does disclose the polishing rate of the dielectric layer relative to copper and barrier material. However, only when the oxidizing agent/corrosion inhibitor weight ratio approaches 25:1 is the rate of removal of barrier material greater than that of copper. Interestingly, at these same parameters, the rate of removal of dielectric material is intermediate to that of the barrier material and copper. In short, neither cited reference is silent regarding the polishing rate of the dielectric layer.

The Examiner is reminded that applicants' claimed second CMP slurry provides the following relative rates of removal during the second step of CMP processing: barrier material > copper > dielectric material. In contrast to Kaufman, applicants achieve these relativistic rates when the oxidizing agent/corrosion inhibitor weight ratio in the second slurry is less than one.[4]

As such, the combination of Mravic and Kaufman does not teach or suggest applicants' second slurry wherein the oxidizing agent/corrosion inhibitor weight ratio in the second slurry is less than one.

The Examiner is reminded that the mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 16 U.S.P.Q.2d 1430 (Fed. Cir. 1990). Not only must the Examiner's rejection be specific as to how one of ordinary skill in the art would have found it obvious to combine references, the Examiner must explain with specificity what areas of the references suggest the combination. See, e.g., *Ex parte Humphreys*, 24 U.S.P.Q.2d 1255, 1262 (B.P.A.I. 1992).

In the present case, no motivation to combine the different slurries is provided in either Mravic or Kaufman. For example, there is no motivation in Mravic to modify the second slurry, as evidenced by the disclosure in Mravic that the CMP process of such reference "achieves many, if not most of the requirements for CMP copper polishing . . . includ[ing] high copper removal rates and minimal dishing and erosion" (see Mravic, col. 8, lines 33-39). Thus, if Mravic contends that his CMP process is

[4] support for this amendment can be found in the instant application on page 15, Table 3.

successful when formulated as disclosed in the reference, why would one skilled in the art be motivated to alter Mravic's CMP process according to applicants' claimed invention? Clearly, there is no reason.

More importantly, Kaufman expressly states that:

> "It is important that the second CMP slurry include a far smaller amount of complexing agent [i.e. corrosion inhibitor] in comparison to the weight amount of oxidizing agent in the slurry."

See Kaufman, col. 8, lines 21-26. Why (and how) would one skilled in the art refer to Kaufman, which specifically states that it is **important** for the second slurry to have a greater amount of oxidizing agent relative to corrosion inhibitor, to arrive at applicants' claimed second slurry which requires an oxidizing agent/corrosion inhibitor weight ratio less than one?

It therefore is evident that nothing in Mravic or Kaufman suggests their combination, and the combination of Mravic and Kaufman does not in anyway disclose or provide any extrapolative or derivative basis for applicants' claimed invention. Accordingly, applicants respectfully request that the rejection of claims 1-8, 10-17 and 20-56 over Mravic in view of Kaufman be withdrawn.

In the July 15, 2003 Office Action, claim 1 was rejected under 35 U.S.C. §103(a) as being unpatentable over Kaufman alone, or alternatively in view of Farkas et al. (U.S. Patent No. 6,001,730) (hereinafter Farkas). Applicants respectfully traverse this rejection and submit that Kaufman alone, or in combination with Farkas, fails to teach or suggest applicants' claimed invention.

According to the Examiner, it would have been obvious to one of ordinary skill in the art to modify Kaufman, or in the alternative to incorporate Farkas into the process of Kaufman, because both are used for the "same purpose" (see July 15, 2003 Office Action, page 6, lines 15-17). Applicants vigorously disagree.

There is no motivation or suggestion in Kaufman to modify the CMP process to yield applicants' claimed invention. As discussed hereinabove, Kaufman expressly emphasizes the **importance** of an oxidizing agent/corrosion inhibitor weight ratio that is greater than about 10:1 and preferably greater than 25:1 (see Kaufman, col. 8, lines 21-26). The date of Kaufman's Table 3, reproduced hereinabove, underscore this importance. In contrast, applicants claimed invention is directed to removal of barrier material at a